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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/670,601	09/26/2003	Tomoo Satoh	Q77623	9902

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EXAMINER	
JAWORSKI, FRANCIS J	
ART UNIT	**PAPER NUMBER**
3737	

DATE MAILED: 01/06/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/670,601	SATOH, TOMOO	
	Examiner	Art Unit	
	Jaworski Francis J.	3737	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *28 September 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1 - 8* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1 - 8* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *28 September 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *09282003*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Specification

The disclosure is objected to because of the following informalities:

The specification should be reviewed for instances of grammatical awkwardness for example page 2 line 11 "raises" to --arises--, lines 12 – 17 read awkwardly in setting forth the relationship between channel number and transducer number; lines 20 – 21 -- a "sparse array is used in which only part of the...--, and so forth.

Page 17 line 6 add -- B – at end-line (see page 16 lines 16 – 19).

Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1 – 3,4 (see qualifier immediately below) and 7-8 are rejected under 35 U.S.C. 102(b) as being anticipated by any of the following ultrasound transducer array devices and claim 4 is also so rejected (save for Okada et al),

where a connecting means in these devices is inherent and includes an electrode pin set (Claim 2) where a discrete connector is invoked, whereupon the identification information is used to affect delay or sensitivity and therefor the waveform via channel adjustment is made:

Tsuchiko et al (US5251631) probe connector element 30 and col. 5 lines 28 – 58 identifying channel sensitivity and phase calibration data,

Okada et al (US5657761) probe type and transmission power identifying signals A,B of Fig. 1.

Magrane (US4893284) PROM 16 storing channel time delay error compensation,

Ikeda et al (US4811740) connector memory 2 storing delay and probe pitch curvature, focus and aperture information, see col. 5 lines 1 – 17.

Snyder et al (US6120449) elements 24, 36, 56-60 are on board the probe which feeds through the system connector and updates the flash memory 58 to bridge or short defective elements in a two-dimensional array in order to increase manufacturing yield, see col. 2 lines 3 – 41. Snyder et al is a type of probe defective element re-optimization and therefore is the core art vis-à-vis applicant's actual problem solution.

As noted above, Okada et al is inapplicable against claim 4 since it is confined to amplitude/sensitivity not delay as a control. Snyder et al in particular entertains supplying channel-specific phase data to the beamformer, tantamount to delay control via the connecto ID, see col. 9 line 66 – col. 10 line 9.

In each instance the connectors are set up so that the connection to selected transducer elements is accomplished for different probes including for example in Ikeda et al for probes of fundamentally different type and in Snyder et al for different connections due to individual element failures in individual probes. (Claim 3).

In the instance of claim 3, whereas applicant is invoking the feature whereby a probe identifier assigned during manufacture testing of the probe for defects is used to locally invoke probe arrangement delay and connections-usable information in either a locally stored disc 28 or retrievable over a network (see spec page 22 line 12 – page 23 line 10) the broadest reasonable interpretation includes arrays or systems having configurable connectors to accommodate different probes. Hence:

Claim 3 is rejected under 35 U.S.C. 102(b) or in the case of Brock-Fisher 102(e)as being anticipated by any of:

Uchiumi et al (US5092337) connector ID information acts on 13 to configure electrode connection via 4 based upon the type of probe used, see col. 1 line 6 – col. 2 line 27.

Brock-Fisher (US6500126) teaches adapter-connector 42 such that different and otherwise incompatible probes may be used interchangeably by systems of different manufacturers, see col. 2 lines 30 – 55.

Snyder (US5520187) differently configures a probe via its connector such that it may flexibly operate on different ultrasound systems, see col. 2 lines 48-

65. Therefore literally the connector system is such that plural connection electrodes are set up for each probe and therefore for plural probes.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claim 2 – 3 are further rejected under 35 U.S.C. 103(a) as being unpatentable over the above references, further in view of Brisken et al (US5209235). If applicant's literal short/open circuit system of specification page 9 line 15 – page 10 line17 is entertained for claim interpretation in a narrow sense then it would have been obvious in view of Brisken et al to so binarize a digital identification circuit 26 as per Figs. 6A-6D and col. 3 line 66 – col. 4 line 6 in order to simplify the transfer of identification information without advanced logic to interpret same..

Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Snyder et al in view of Haider (US6565510). The former is applied as above, save that in this instance it is narrowly construed that the aforementioned providance of phase information to the beamformer is not literally tantamount to delay amount control or to a computed re-optimization of delay based upon defective elements of the array. It would nonetheless have been obvious in view

of Haider col. 8 lines 9 – 55 to re-optimize delay or individualize delay profiles based upon the presence of defective elements since Haider of GE is also interested in increasing the service usability of ultrasound imaging arrays, see col. 3 lines 14 – 37 and recognized that remote re-optimization was equivalent to local re-configuration of an earlier GE system such as Snyder et al, see col. 10 lines 57 – 63.

Claim 5-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over any of the references Tsuchiko et al, Snyder et al in view of Haider, Magrane as applied against claim 4 above, and further in view of Ikeda et al, or in the case of Ikeda et al as applied above, as obvious over Ikeda et al alone. In all instances since Ikeda et al notes col. 1 lines 29-46 that one may pre-store the entire body of channel delay information for a batch or population of probes for subsequent readout if one is willing to suffer the large memory requirement, it would have been obvious at the time of invention to consider such since memory subsequently became much cheaper and more flexibly transferable.

Patentability Assessment

The Examiner and the applicant are faced with a wide gap here between what each sees as patentable subject matter. From the Examiner's point of view the gap arises because applicant is claiming into subject matter which is densely populated with prior art (probe identification/encoding with characteristic/arrangement information and/or pre-stored channel parameter data

or flexible connections) and claiming away from subject matter areas to which less attention has been paid by those of ordinary skill (system re-configuration/re-optimization of transducer working elements i.e. 'smart' re-configuration to increase salvageable yield) or little attention has been paid (re-optimization/re-randomization of sparse arrays to accommodate defective elements).
[Note: the Examiner is characterizing applicant's working embodiment as effectively a random sparse array since page 19 line 23 and page 20 line 19 as well as the proferred IDS prior art suggest same.]

Two strategems are being fronted to bridge this gap:

First, Multiple primary and/or secondary references have been provided in rejection along two lines (non-Snyder et al based rejections address the broad issue of probe connector characterizing information storage or individual probe-based system configuration, i.e 'broadest reasonable interpretation' and Snyder et al – based rejections alone or together with Haider and/or Ikeda et al address the narrow issue – probe-ID based re-optimization of array operation in the face of defective elements, i.e. that problem towards which the applicant is actually applying the delay compensations to) in order to ensure that the probe connector identification art is thoroughly considered in the event that applicant intends to continue claiming along that line.

The following additional ultrasound probe identification art completes the smart or self-identifying probe topic as well as calibrated pre-storage teachings:

Little et al (US6364839) – connector storage of ultrasound array signal processing tables (col. 4 lines 28 – 32) and operational software (col. 2 lines 43 – 57).

Uchida et al (US4545251) pre-storage of a reference scan set for echo strength later used in flaw characterization, col. 6 line 24 – 7 line 12.

Crowley (US5544660), Cockburn (US6053871) teach informational encoding of probe type in the connector.

Shinomura et al (US5891041) - a probe code when input by operator retrieves frequency ratio used to compute focus parameters, see 114a-c.

Second, the largely unclaimed topics of compensation optimization for defective elements and of re-optimization of a sparse array of random or pseudo-random type having defective transducers in particular are dealt with constructively here.

With respect to defective transducer element compensation/re-optimization in general -

Fink (US5092336) proposes storage into memory of time-reversed echo signals to apply in compensation due to inter alia defective transducer elements in order to sharpen delay focus in a flaw-detecting or therapeutic ultrasound environment, see col. 3 lines 14 – 51 and col. 8 lines 3 – 42.

Burke et al (US5517994) proposes self-testing by the system with gain or time delay compensation of out-of-tolerance elements

Yao (US5676149) is directed to adjacent element gain adjustment to compensate for defective elements in a transducer array.

Snyder et al (US6120449) as noted is directed to shorting or patch connection bridging of defective transducer elements to adjacent elements of a two-dimensional array by storage of transducer switching states in the probe connector.

Haider (US6565510) as noted is directed to remote Internet based mathematical re-optimization of an array for its defective elements by controlling gain and weighting functions of remaining elements see col. 8 lines 9 – 55 or alternatively to practice of same in a local system controller, col. 10 lines 57 – 63.

Sasaki et al (US6656119) is directed to identifying defective transducers either via a network (col. 4 lines 4 – 47) or locally in the system controller (col. 15 lines 22 – 39) for purposes of tracking probe degradation and without compensatory protocols.

With respect to sparse arrays of random or pseudo-random type –

The Davidsen et al citations in applicant's IDS filed 9-26-2003 are directed to mathematical analysis of parameters of sparse random arrays and array fabrication technology without attention to re-optimization or salvage of yield for defective elements.

Steinberg et al (US5808962) col. 13 line 57 – col. 15 line 18 compares random and periodic ultrasparse ultrasound area array spacings.

(US6503204)

Sumanaweera et al is directed to fabrication of a random sparse array on a hexagonal grid spacing for greater element density.

Song (US5893832) teaches random array element alignment on circular grids to reduce sidelobes, see col. 2 lines 10 – 17.

Holm (US6279399) suggests the option of 2D/3D alternative array scanning by inter alia selecting a sparse random array (Xses of Fig. 1) according to an optimization routine, see cols. 2 line 27 – 34 and 7 lines 7 – 18.

Chiang et al (US6552964) in Fig. 1 and col. 4 lines 22 – 56 is directed to pseudorandom array spacings computed to minimize sidelobe energy in the application scenario of simultaneous parallel processing for real-time 3D sonar ranging.

Grenon et al(US6783497) suggests an asymmetric aperture sparse circular array as an alternative to random array dispersed sidelobe problems and contemplates accepting a certain fraction of defective elements without image degredation, see col. 3 lines 27 – 64 and col. 8 lines 9 – 12.

Accordingly with respect to general optimization for defective transducers the prior art does not teach or suggest an ultrasound system which re-optimizes or reconfigures in the face of defective elements by selecting at least some elements other than the originally selected ones among still working elements for array re-optimization, irrespective of whether the primary information about the element defects resides in a 'smart' probe connector, in the system controller's memory or at a remote network site by virtue of an interrogation sweep or

forwarded pre-calibrations from the probe manufacturing process. Nor does the prior art teach or suggest a re-optimization process for a random array in the face of defective elements which involves re-selection of new contributing elements, i.e. apart from the change in active element set imparted by dead load as per e.g. Grenon et al. Additionally with respect to smart probes or other modes to access pre-alibration storage the prior art does not teach or suggest the interaction of probe connector or probe-resident identification information with the ultrasound system to accomplish such transducer defect element re-selection or random array re-optimization by selection of new contributing elements.

Newly presented claims which otherwise fairly meet the criteria for restriction may be subject to restriction by constructive election however if an excessive administrative burden results, see MPEP Section 821.03.

Any inquiry concerning this communication should be directed to Jaworski Francis J. at telephone number 703-308-3061.

Francis J. Jaworski
Primary Examiner

FJJ:fjj

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